Focused Project: High Throughput Methods for the Evaluation of Adhesive Performance

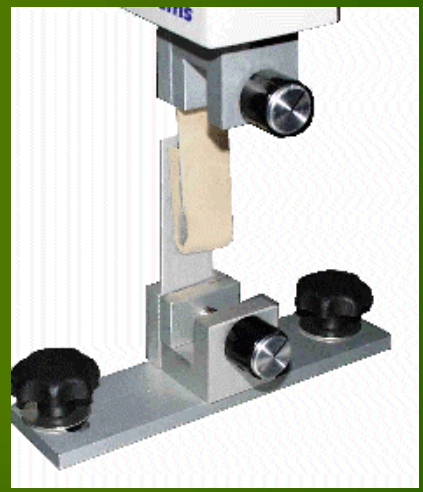
Christopher M. Stafford, Aaron Forster,
Arnaud Chiche, Alamgir Karim

Common Performance Tests

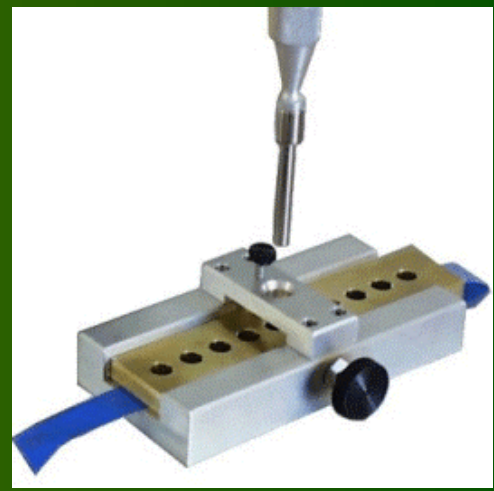
- Peel test provides *qualitative* information utilizing fast peel rates.

- Probe test provides *quantitative and qualitative* information on adhesive debonding at a rate typically less than 1 mm/s.

- Both methods employed to measure adhesion across a narrow parameter space.



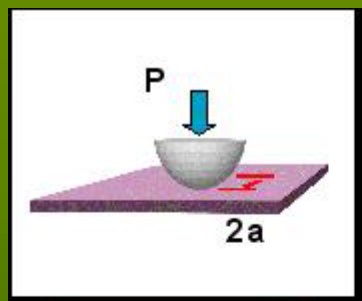
Peel Test



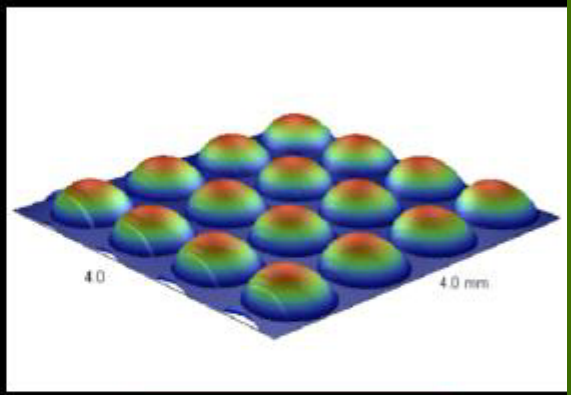
ProbeTest

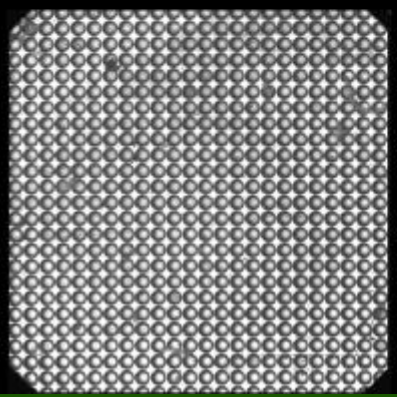
Measure load as a function of displacement.

MCAT Background



$$G = \frac{3(P'-P)^2}{32\pi E a^3}$$



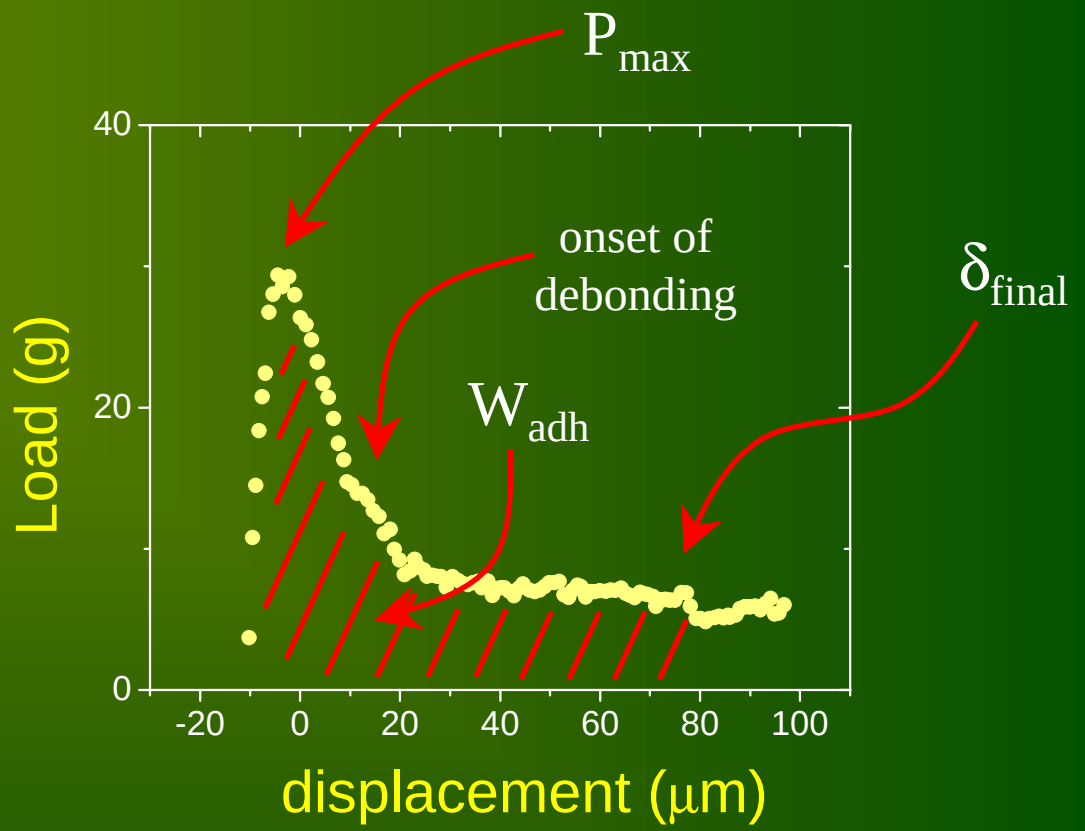


$$G = \frac{2E(\delta' - \delta)^2}{3\pi a}$$

- Similar to probe tack test, but lower confinement.
- MCAT measures adhesion over more than one contact point simultaneously, thus encompassing a wide range of parameter space.
- MCAT instrument permits measurement of load, contact area, and displacement.
- This information is invaluable to understanding the debonding process between the probe and the pressure sensitive adhesive.

Identifying Parameters

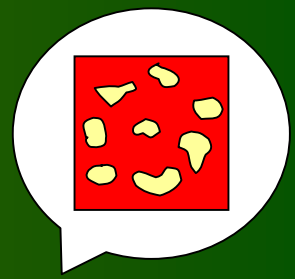
ProbeTest



Approach

Library Fabrication

thickness composition
tackifier crystallinity



Library Characterization

adhesion/tack (quantitative?)
morphology
surface vs bulk compositions
mechanical properties

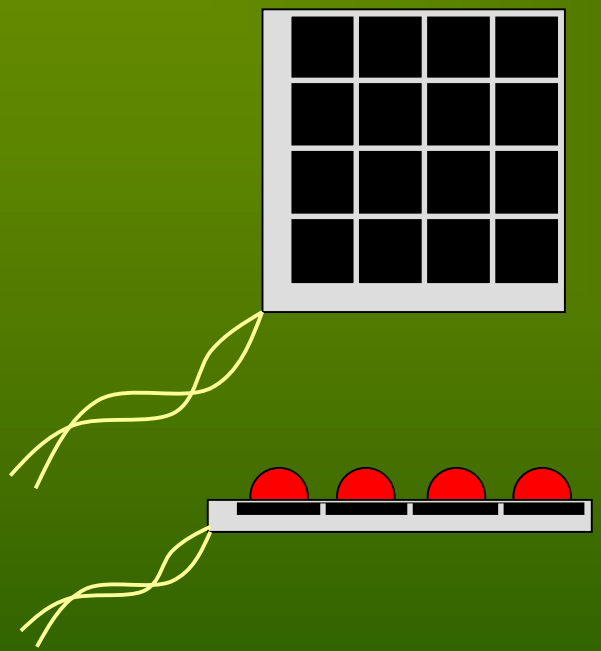
Analysis

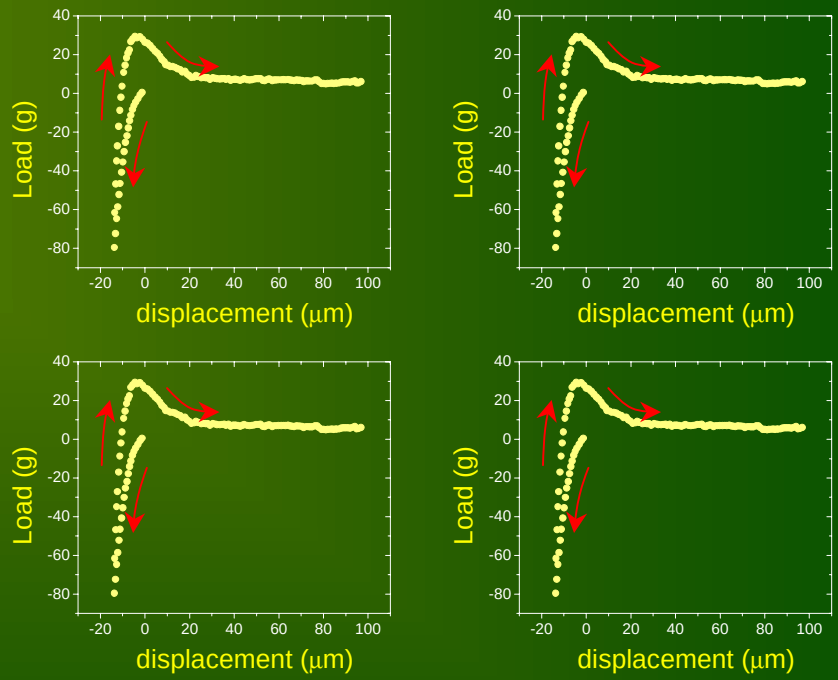
Structure/property relationships
(physical, chemical, adhesive)
debonding mechanisms

Calibration

benchmark against other
test methods and/or other
testing environments

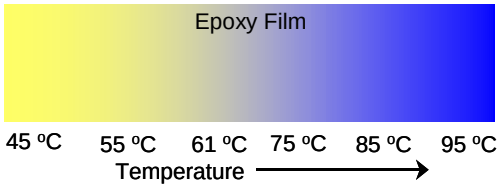
Step 1: Pressure Sensor Array



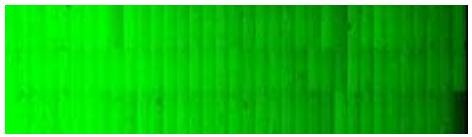


- Arrays are available with elements of:
  4x4, 8x8, and 16x16.
- Range of pressures:
  3 psi, 12 psi, and 20 psi.

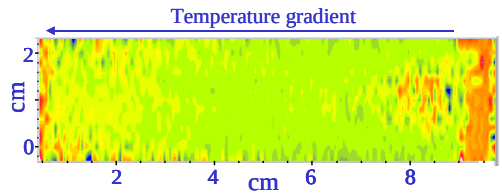
Characterization of Gradient Epoxy Curing †



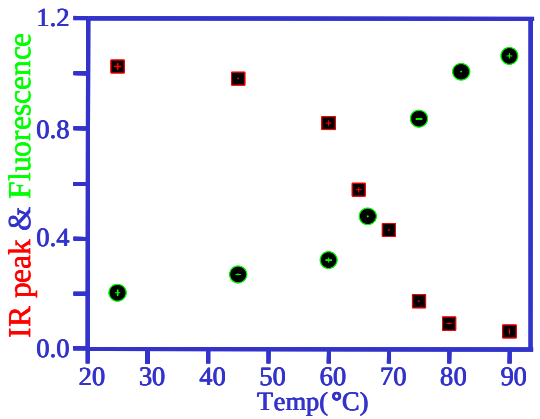
A diglycidyl ether bisphenol A epoxy resin was cured across a temperature gradient from 15 to 120 minutes.



Monitor **network formation** (confocal microscopy)

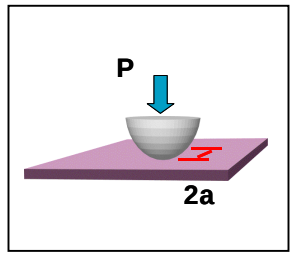


Monitor **reaction chemistry** (FTIR-reflectance)

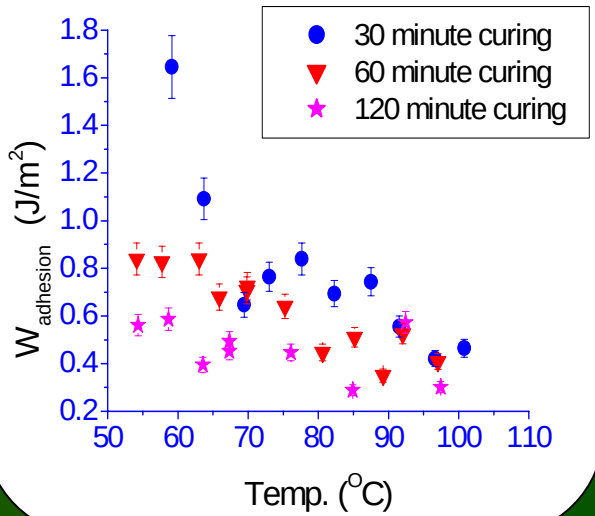


■ Epoxy peak area (FTIR microscope)

● Fluorescence intensity/3000 (Confocal)



Monitor **adhesion** (single lens tack test)

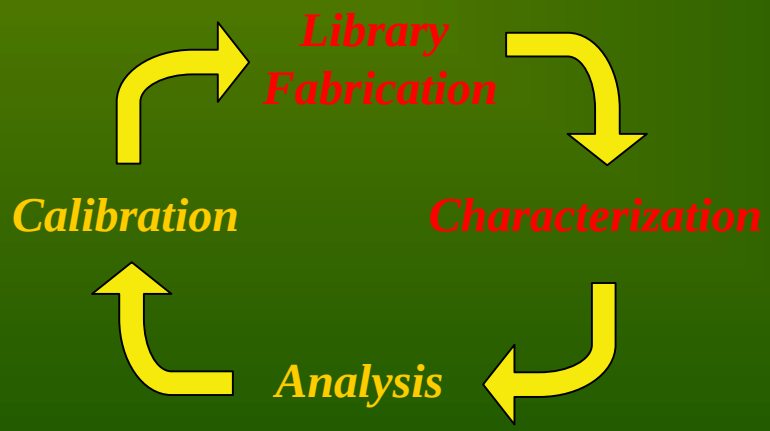


†D. Raghavan, N. Eidelman, A. Forster

Project Deliverables

Year 1

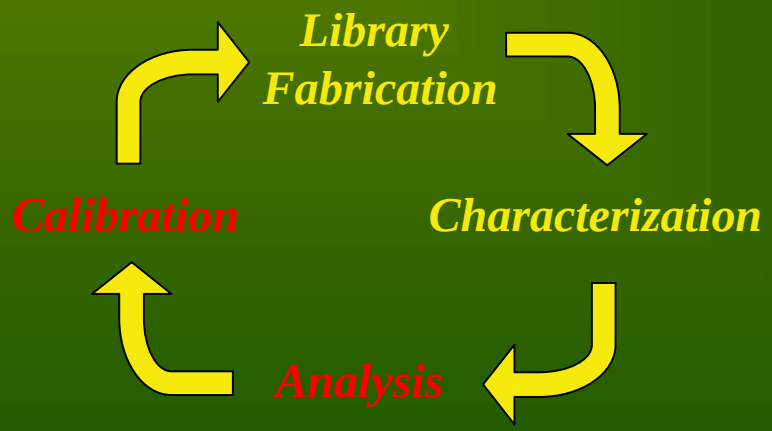
- Select suitable model polymer adhesive tackifier blend system, and define parameters and variables for testing.
- Conduct preliminary tests on at least one selected model polymer adhesive film system.



Project Deliverables

Year 2

- Incorporate library generation and testing of adhesive films, and integrate system with the NCMC informatics database.
- Draw correlations, if any, between peel-tests and MCAT-PSA tests.
- Allow focused project members to investigate a suitable non-proprietary commercial blend system.



Membership Fee: The membership fee payable to NIST is $20,000 per year.